original Claim 4, which recites that steam is present in the mixed gas, meaning that original Claim 1 was inclusive of the presence or absence of steam. See also the specification at page 13, line 19ff, and the disclosure before it. Claim 4 has been canceled. New Claim 14 has been added, as supported in the specification at page 29, line 8ff and Table 1.

No new matter has been added by the above amendment. With entry thereof, Claims 1-3 and 5-14 will be pending in the application.

REMARKS

The rejection of Claims 1-13 under 35 U.S.C. §103(a) as unpatentable over U.S. 5,635,102 (Mehta) "as applied to claim 1 above, and further" in view of U.S. 5,922,624 (Verhaverbeke et al), is respectfully traversed. (The quoted matter appears to be redundant.)

As recited in Claim 1, the present invention is a process for cleaning a surface of a substrate, said surface carrying thereon a high-density film and a low-density film lower in density than said high-density film in combination, which comprises continuously bringing a mixed gas of anhydrous hydrogen fluoride gas and a heated inert gas into contact with said surface of said substrate such that at least a portion of said low-density film is removed without impairing said high-density film beyond a tolerance, wherein the mixed gas does not contain steam.

Mehta is from the same patent family as JP 8-319,200 A, which is described in the specification at page 5, lines 18-22; page 6, line 15, through page 8, line 14; page 21, lines 8-11; and page 22, line 23, through page 23, line 6. Mehta discloses a process for selectively removing a porous silicon oxide layer from a substrate having a portion thereon with an exposed dense silicon oxide to be retained on the substrate, the porous silicon oxide layer containing absorbed moisture therein, the process comprising introducing the substrate to a

flowing anhydrous gaseous environment consisting of anhydrous inert gas, adding anhydrous hydrogen fluoride gas to the gaseous environment for a pulse time which is at most only shortly longer than that required to initiate etching of the dense silicon oxide, flushing the gaseous environment with anhydrous inert gas for a time sufficient to remove the hydrogen fluoride and water vapor generated by the etching of the porous oxide, and repeating the adding and flushing steps until the porous oxide layer has been removed (abstract). Thus, in Mehta, the anhydrous hydrogen fluoride gas does not flow continuously, as required by the present invention, but in pulses. As an example, Mehta discloses the use of 2 to 9 pulses between about 3 and 8 seconds each, preceded and interspersed by flush cycles of up to 60 seconds each (column 4, lines 39-42). There is no disclosure or suggestion in Mehta to flow the anhydrous hydrogen fluoride gas therein continuously.

Recognizing that Mehta does not disclose or suggest continuous application of the presently-recited mixed gas, the Examiner relies on Verhaverbeke et al.

Verhaverbeke et al is drawn to the etching of SiO_2 layers by HF vapor etching. Verhaverbeke et al disclose that traditionally, HF vapor etching is performed with a mixture of HF and H_2O vapors at near atmospheric pressures in a mode where the process gases are continuous flowing, the so-called dynamic mode, but because of controllability problems with this process, it has been improved by performing it at substantially reduced pressures, and applying a different procedure, the so-called static mode; despite these improvements, the controllability of the process is still problematic (column 2, lines 1-11). The invention of Verhaverbeke et al is an improvement over this prior art, and involves the use of gaseous mixtures of hydrogen fluoride and one or more carboxylic acids, and which can be performed in the static mode or the dynamic mode.

It is not clear why one skilled in the art would combine Mehta and Verhaverbeke et al. Mehta is concerned with selectively removing a porous silicon oxide layer from a substrate having a portion thereon with an exposed dense silicon oxide to be retained on the substrate, and involves the use of anhydrous hydrogen fluoride. Verhaverbeke et al, on the other hand, is not concerned with **selective** removal of one out of two silicon oxide layers, and is not concerned with **anhydrous** hydrogen fluoride. In addition, Verhaverbeke et al do not disclose any advantage from using a dynamic mode in place of a static mode. Indeed, in the disclosure of Verhaverbeke et al relied on by the Examiner, i.e., column 2, lines 1-15, the static mode was intended to be an improvement over the dynamic mode. If anything, this disclosure teaches away from replacing the pulse treatment of Mehta with a continuous treatment. Moreover, if a proposed modification would render a prior art invention unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 221 USPQ 1125 (Fed. Cir. 1984) (copy of record). See also MPEP 2143.01. Indeed, Verhaverbeke et al is essentially irrelevant with regard to selective etching processes using anhydrous hydrogen fluoride gas.

In the present Office Action, the Examiner, in essence, ignores all the above-discussed differences between Verhaverbeke et al and Mehta, and Verhaverbeke et al and the present invention, reducing the disclosure of Verhaverbeke et al to one of suggesting an interchangeability between a static mode and a dynamic mode. The Examiner ignores the fact that Verhaverbeke et al's disclosure of interchangeability is with regard to Verhaverbeke et al's mixture of gases comprising hydrogen fluoride and at least one carboxylic acid. Verhaverbeke et al disclose and suggest nothing with regard to anhydrous hydrogen fluoride gas etching, and especially such etching in the absence of steam, as now required by the claims. Note that in Verhaverbeke et al's invention, water is not excluded (column 4, lines 5-

9). One skilled in the art reading Verhaverbeke et al would expect that if water were not used with hydrogen fluoride, then a carboxylic acid would have to be used. But the use of anhydrous hydrofluoric acid *per se* is not suggested.

If it were obvious to change Mehta's pulse treatment to a continuous treatment, it is surprising that Mehta did not disclose a continuous treatment, since a continuous treatment is much simpler than the pulse treatment therein. The only reasonable conclusion therefrom is that Mehta could not achieve satisfactory results using a continuous treatment.

The Examiner is also referred to the Examples and Comparative Examples in the specification herein, and particularly Comparative Example 3, which is analogous to the pulse treatment of Mehta. As Applicants describe in the specification at page 45, lines 16-23:

> It has, however, been found that under the conditions of this Comparative Example, complete removal of water formed on the surface is difficult basically and the degree of selective removal of the film is inferior to those achieved in the Examples. Further, compared with Example 1, Comparative Example 3 requires considerably longer dipping time and is also inferior in economy.

For all the above reasons, it is respectfully requested that the rejection be withdrawn.

All of the presently-pending claims in this application are believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

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Amendment Filed on:
HEREWITH

IN THE SPECIFICATION

Please replace the paragraph at page 44, lines 5-18 as follows:

--Although the tolerance of a loss differs depending on the device or step, a thermal oxide film is widely used, for example, as a gate oxide film or the like in many instances, and a loss may be considered to be acceptable if it is [1 nm (10 Å)] <u>0.1 nm (1 Å)</u> or so when the thermal oxide film is 10 nm (100 Å) in thickness. Nonetheless, the loss in this Comparative Example was not considered to be sufficient when compared with the loss in Example 1. It has, therefore, been found that the conditions used in this Comparative Example are not considered to be optimal for the removal of an oxide film which does not have high selectivity and is small in thickness. This is however not always the case, and the conditions of this Comparative Example are still sufficient for the treatment in a step in which a large tolerance is permissible with respect to a loss.--

IN THE CLAIMS

--1. (Twice amended) A process for cleaning a surface of a substrate, said surface carrying thereon a high-density film and a low-density film lower in density than said high-density film in combination, which comprises continuously bringing a mixed gas [of] <u>comprising</u> anhydrous hydrogen fluoride gas and a heated inert gas into contact with said surface of said substrate such that at least a portion of said low-density film is removed

without impairing said high-density film beyond a tolerance, wherein the mixed gas does not contain steam.

4. (Canceled)

14. (New)--